

WHAT IS CLAIMED IS:

1. An up-conversion fiber laser apparatus for exciting a rare-earth-doped fiber by a laser beam, comprising:

5 a polarizer and a high-reflection mirror for retrieving an up-conversion laser output, which are arranged between an exciting laser for emitting an exciting laser beam and the rare-earth-doped fiber, wherein that portion of the exciting laser output
10 from the output side of the rare-earth-doped fiber which has polarized waves at right angles to the polarized waves of the light beam incident or the rare-earth-doped fiber is returned into the rare-earth-doped fiber again, and the exciting laser beam having the
15 other polarized waves are output in a direction different from the exciting laser.

2. A fiber laser apparatus according to claim 1, wherein the polarizer and the high-reflection mirror are formed integrally with each other.

20 3. A fiber laser apparatus according to claim 2, further comprising:

 a separator interposed between the high-reflection mirror and the output side of the rare-earth-doped fiber for separating the up-conversion laser output
25 from the rare-earth-doped fiber and the exciting laser beam having the other polarized waves from each other.

4. A fiber laser apparatus according to claim 3,

wherein the rare-earth-doped fiber has doped thereto at least one of Pr, Yb and Tm.

5. A fiber laser apparatus comprising:

an exciting laser for emitting an exciting laser beam;

an up-conversion fiber excited by the exciting laser beam and adapted to output a laser beam of a wavelength predetermined in accordance with the rare-earth doped in advance;

a polarizer interposed between the exciting laser and the up-conversion fiber for transmitting the light beam having a polarized wave component unique to the exciting laser beam and reflecting the light beam having a polarized wave component at right angles to the unique polarized wave component; and

an output mirror arranged on the output side of the up-conversion fiber and adapted to guide, in a predetermined direction different from the exciting laser, the output laser beam output from the up-conversion fiber and the portion of the exciting laser beam not contributing to the excitation of the up-conversion fiber of the exciting laser beam.

6. A fiber laser apparatus according to claim 5,

wherein the polarizer is arranged in such a manner that the polarized light beam component of that portion of the exciting laser beam transmitted through the output mirror and not contributing to the excitation

of the up-conversion fiber which is at right angles to the polarized light beam component incident on the polarizer from the exciting laser can be input to the up-conversion fiber.

5 7. A fiber laser apparatus according to claim 6, further comprising a separator arranged downstream of the output mirror for separating the output laser beam of the up-conversion fiber from that portion of the polarized light beam component of the exciting laser
10 beam transmitted through the polarizer which fails to contribute to the excitation of the up-conversion fiber.

 8. A fiber laser apparatus according to claim 7, wherein the rare-earth-doped fiber has doped
15 thereto at least one of Pr, Yb and Tm.

 9. An exciting method for an up-conversion fiber laser apparatus for exciting a rare-earth-doped fiber by a laser beam, comprising the steps of:

 separating specific polarized waves of the
20 exciting laser beam of an exciting laser using a polarizer;

 supplying the exciting laser beam of the separated polarized waves to the rare-earth-doped fiber for up-conversion and producing a laser output by resonance;

25 returning part of the exciting laser beam emitted with the laser output from the rare-earth-doped fiber, to the rare-earth-doped fiber in association with the

direction of polarization; and

causing the exciting laser beam emitted with the laser output from the rare-earth-doped fiber in the same direction as the laser output due to the direction of polarization to proceed in the same direction as the direction of the laser output.

10. An excitation method for an up-conversion fiber laser apparatus according to claim 9,

wherein the polarized waves of the exciting laser beam returned to the rare-earth-doped fiber again and the polarized waves of the exciting laser beam emitted in the same direction as the laser output by the polarizer from the rare-earth-doped fiber are directed at right angles to each other.

11. An excitation method for an up-conversion fiber laser apparatus according to claim 9, further comprising:

wherein the exciting laser beam emitted in the same direction as the laser output from the rare-earth-doped fiber is caused to proceed in a direction different from the direction of the laser output by use of a mirror capable of reflecting the infrared light.

12. An image display apparatus comprising:

a plurality of fiber laser apparatuses, each apparatus outputting a red light beam, a green light beam and a blue light beam;

a plurality of spatial modulation elements, each

spatially modulating the light beams output from the fiber laser apparatuses;

means for synthesizing the red light beam, the green light beam and the blue light beam spatially modulated by the plurality of the spatial modulation elements; and

an optical element for focusing the output light of the synthesis means at a predetermined position;

wherein at least one out of the plurality of the fiber laser apparatuses includes a polarizer inserted between an exciting laser for emitting an exciting laser beam and a rare-earth-doped fiber, and a high-reflection mirror for retrieving an up-conversion laser, and

wherein that portion of the exciting laser beam output from the output side of the rare-earth-doped fiber which has polarized waves directed at right angles to the polarized waves incident on the rare-earth-doped fiber, is returned to the rare-earth-doped fiber, and the exciting laser beam having the other polarized waves is output in a direction different from the direction of the exciting laser.

13. An image display apparatus according to claim 12,

wherein the rare-earth-doped fiber has doped thereto at least one of Pr, Yb and Tm.

14. An image display apparatus according to

claim 12, further comprising:

a white light generating mechanism for processing each of the output light beams of the plurality of the fiber laser apparatuses in such a manner as to form

5 a substantially white light beam;

wherein the spatial modulation element is single in number and spatially modulates the output light beam of the white light generating mechanism in accordance with the image information to be displayed.

10 .15. An image display apparatus according to claim 14,

wherein the rare-earth-doped fiber has doped thereto at least one of Pr, Yb and Tm.